considerable quantities of culture media, and by chemical methods isolated and extracted the ptomaines and albumoses that the germs form.

These poisonous liquids have been injected into guinea-pigs, and the animals then inoculated with the virus of the disease. The guinea-pigs which had thus been treated were not seriously affected by the virus, while the guinea-pigs which had not been treated by injecting the remedy invariably died. Both swine-plague and hog-cholera have thus been prevented in guinea-pigs, which are very susceptible to the diseases.

Some experiments have also been made upon hogs, which have been fairly successful; and there is every reason to expect that this method of treatment can shortly be applied on a practical scale. It may be mentioned that the scientific results of these experiments were published in the Philadelphia *Medical News* of September and October, 1890.

While Professor Koch has been working for the benefit of mankind, the secretary of agriculture of the United States has had the pecuniary interests of the farmer and the safety of animals at heart in encouraging this difficult line of investigation; and results have been secured which are far-reaching in their importance and application for men as well as animals.

Professor Koch, in treating consumption, uses a solution the composition of which he says he does not know. The Department of Agriculture uses substances which are obtained in a solid form, as most drugs, and prepares solutions of any desired strength for treating the diseases of hog-cholera and swine-plague.

There is no reason why this line of research should not be pushed with reference to many diseases of men and animals in the large universities and laboratories of our own country. In the hands of competent investigators, there can be secured in the United States the most important results, and great discoveries can be made. The Scientific Department of the government has shown the way. Let others follow.

SPECIAL PLANTING FOR HONEY.

IT is a well-known fact, and as thoroughly appreciated by the thoughtful bee-keeper, that often, because of some peculiar condition of the weather, even our best honey-plants fail to secrete nectar. In Michigan the years 1888 and 1890, and to a less degree 1889, gave excellent illustration of this fact in respect to white clover.

Again, it frequently occurs that a drouth or over-production the previous season so weakens plants that they do not develop to the blossoming stage, or do not produce blossoms. This very season, 1890, gave us almost no basswood bloom. The same truth is illustrated not infrequently by almost all of our nectar-secreting plants.

Once more, there are times in every season and region when there is a dearth of nectar-secreting flowers. In Michigan this period comes about July and August, usually from about July 15 to Aug. 15. At this season there are neither native honey-plants in bloom, nor are there honey-plants in cultivation So at this season the bees are idle, and robbing is a common occurrence.

For the above reasons bee keepers are much interested to know if there are plants that will always secrete nectar irrespective of weather,—plants that will secrete not simply enough to attract bees, but enough to give a surplus and insure a profit. They are also practically interested in knowing whether or not there are plants that will secrete so liberally that it will pay to grow them for honey alone. It is further a matter of importance to find if there are plants that bloom at the time of the honey-dearth in July and August, and so, valuable to grow, either for honey alone or for honey and other purposes. There are always more or less waste places, by roadsides, along railways, etc., near by most apiaries. It is important to know if it will pay to utilize such by planting for honey, and, if so, to know what to plant.

That these are important matters for investigation is clear from the fact that many bee-keepers have spent considerable sums in trying to solve these questions.

It is clear, that, to arrive at any definite and reliable conclusions, experiments must be tried on a large scale. We must not see simply that bees work on the flowers, but we must get results. We must be assured that the bees actually store, and that in paying quantities.

It occurred to me, and to the board of our Michigan experiment station, that this was a very proper subject for investigation at our station, and so for the past two seasons we have devoted about fourteen acres to this purpose. The seasons have been very opportune, as there was an almost total failure in the honey-harvest both years; and so, if any plan adopted was a success, it would have ample chance to prove its excellence.

I decided to try the three following honey-plants: Rocky Mountain bee-plant (*Cleome integrifolia*), Chapman honey-plant (*Echinops spherocephalus*), and a foreign mint of the genus *Melissa*. I hoped to find a plant that would secrete nectar every year, especially in times of drouth, that would grow with little or no care on the part of the bee-keeper, and would yield bountifully of nectar. As the Chapman honey-plant was loudly praised, and was reported a success upon actual trial, and as the seed had been distributed by the government, it occurred to me that it should be one of the plants first tested. The Rocky Mountain bee plant flourishes on the dry plains of Colorado, where it is said to give prodigious yields of nectar; and as I had been quite successful in growing it in small plats for years, where it seemed to attract the bees from early July till frost, I looked upon that plant as well worthy a trial. This plant is also reported as growing wild in Wisconsin and Minnesota, and as affording much nectar. The *Melissa* belongs to the mint family,—a family of honey-plants,—is strongly praised by those who have tried it, and who have no pecuniary interest in its becoming popular: so I concluded to make it third in the list to be adopted.

The Chapman Honey-Plant.

I have planted, in all, four or five acres of the seed of this plant, some on clay and others on sand. When the seed came, the plants made a very vigorous growth, but did not blossom at all the first year. Thus the plant is a biennial. No nectar can be secured from it until the second year after planting. The plant looks like a thistle, the spines doubtless suggesting the generic name *Echinops*. The flowers form a very perfect globe or sphere; hence the specific name *spherocephalus* is very appropriate. The plant, if cultivated till once well started, will care for itself, as it is very vigorous. It begins to bloom here at the Michigan Agricultural College about the middle of July, and continues to blossom till the middle of August. The blossoms commence to open at the lower margin of the head, and continue to open towards the centre. The seasons have been very dry, yet the bees visited the *Echinops* very freely, and secured considerable honey; and this, too, just at the most desirable period of the year.

A very serious objection to the general adoption of this plant is the difficulty of securing the seed. The chaff has barbed awns, that are very minute. These fly everywhere as we clean the seed, and, except one is protected better than he will be unless previously taught by experience, these awns are sure to enter the eyes and pierce the skin at every possible opportunity. The effect of this is almost maddening. For three or four days the pain in the wounded eyes and skin is almost unendurable.

After the plants bear a full crop of seed they seem exhausted, and very few survive to blossom the second year. Our plants in 1889 were wonderfully fine and vigorous: the plants on the same area this year are very few and scattering. To be sure, young plants have come up thickly from seed, but they will bear no bloom till 1891. Thus we see that we cannot grow this plant profitably except as we plant, or permit it to self-plant, every

year, and also that we get no honey till the second season from the seed.

Another serious difficulty is the chance that the seeds may not come. I planted five acres of seed this spring. The seed seemed excellent, the ground was in fine condition, and we had frequent and abundant rains; yet so few of the seeds came, that I ploughed all up, and sowed to buckwheat.

We see, then, that the special planting for honey alone, of the *Echinops*, is not encouraging. The fact that the plant is a biennial, that it is so terrible to thresh, that the seed is likely to fail to germinate, and the fact, if we may judge from analogy, that the plant may not always secrete nectar even though it bloom profusely (our experiments do not prove or refute this point),—all would tend to make the wise bee-keeper hesitate before he grew this plant. It seems more than probable that it will never pay to do so.

The Rocky Mountain Bee-Plant.

I had previously learned that to grow *Cleome* we must plant in autumn. Spring-sown seed will rarely germinate. So in the fall of 1888 I sowed eight acres of *Cleome*. The seed was procured fresh from Colorado. To my great disappointment, the seed did not germinate well. In many places the plants were exceedingly scattering. These plants were on sandy land. Other seed was planted on clay, and did not germinate nearly as well as that sown on sand. The blossoms commenced to open the first of July, and continued to bloom even into September. The season was very dry, the excessive drouth reaching from July till late autumn,—just the time for a Colorado plant to show its virtues. The plant grows from one to three feet high, the foliage is smooth, the leaves compound, and the flower an umbel. The flowerets commence to open below, and continue for a long time.

To my great disappointment, the flowers seemed to furnish very little nectar. The bees worked on the plants only occasionally, and then not excessively. Thus there were two disappointments,—failure of the seeds to germinate, and failure of the flowers to secrete.

We sowed in 1889 three acres with seed of our own raising, which failed almost entirely to germinate. We left three acres uncultivated where the plants were thickest in 1889, to see if the plants would self-seed the ground. Here, too, we were disappointed. There were so few plants, even though the season seemed exceptionally favorable, that both pieces—the one planted and the one supposed self-sown—were ploughed up.

Thus these plants, like the *Echinops*, two as promising species as we could hope to find, promise little in the way of special planting exclusively for honey. The expense and labor; the doubt of growing a crop even though we plant; the chance that the season may not be propitious, and so there be little or no nectar secreted, even though the plants do grow and bloom,—all this makes the prospects for profit in such planting not encouraging.

Melissa.

The *Melissa* is an annual. We planted it for two successive years. It did well, blossomed freely, and was visited very generally by the bees. It grows well on both sand and clay, and, by sowing early, will commence to bloom early in July, and continue in bloom for a month or more. I regret to say that it will not self-seed, and must be planted annually. This is expensive, and it is doubtful if it will pay. It is to be said, however, that *Melissa*, in common with the other mints, seems to attract the bees at all times of bloom, whatever the season: so I am of the opinion, that, if any plant will pay exclusively as a honey-plant, it will be some mint. Many of these are perennial. As the three acres of *Melissa* last season *were* singing with bees all through the time of blossoming, and as our bees swarmed in early August, a thing unprecedented in Michigan, it gives reason to hope, that, with a large average, we might secure a honey-crop each year despite the season.

Thus I believe our experiments indicate that special planting for honey alone is of doubtful practicability; that *Echinops* and *Cleome*, at least, are not the plants for such special planting, if it is ever to be a success; and that while *Melissa*, or bee-balm, is not profitable, as it is an annual, it is possible that the perennial mints are the plants, if any such there be, that will pay us to grow exclusively as honey-plants.

Unless *Cleome* will seed itself, it is not the plant even for wayside planting. I think we must look to some of the persistent mints, or, more probably, to some plant valuable for other purposes even, to plant on the roadside and in waste places.

I hope next to try *Melilot*, or sweet clover, not so much to find whether it is a valuable honey-plant, as we know that now, but rather to find if this luxuriant and vigorous clover may not have other important uses, possibly for silage. I shall also hope to plant small beds of promising mints, in hopes for hints of some plant that will pay just for nectar, and nothing else.

A. J. COOK.

THE RELATION OF GROUND WATER TO DISEASE.

AT the meeting this year of the Royal Meteorological Society, held on Nov. 19, the president, Mr. Baldwin Latham, delivered an address on the above subject.

The pages of history show that when the ground waters of our own or other countries have arrived at a considerable degree of lowness, as evidenced by the failure of springs and the drying-up of rivers, such periods have always been accompanied or followed by epidemic disease. In all probability, ground water in itself, except under conditions where it is liable to pollution, has no material effect in producing or spreading disease. As a rule, it is only in those places in which there has been a considerable amount of impurity stored in the soil that diseases become manifest; and the most common modes by which diseases are, in all probability, disseminated, are by means of the water-supplies drawn from the ground, or by the elimination of ground air into the habitations of the people. It is found that the periods of low and high water mark those epochs when certain organic changes are taking place in the impurities stored in the ground, which ultimately become the cause, and lead to the spread, of disease. Mr. Latham defines "ground water" as all water found in the surface soil of the earth's crust, except such as may be in combination with the materials forming the crust of the earth. It is usually derived from rainfall by percolation, and it is also produced by condensation. In dry countries, ground water is principally supplied by the infiltration from rivers, as, for example, in the Delta of the Nile.

The absence of water passing into the ground for a long period, naturally leads to the lowering of the free ground water-line, and may lead to the drying of the ground above the water-line; and it is curious to note, with reference to small-pox, that the periods marking the epochs of this disease are those in which there has been a long absence of percolation, and a consequent drying of the ground preceding such epidemics. On the other hand, small-pox is unknown at such periods as when the ground has never been allowed to dry, or is receiving moisture by condensation or capillarity.

The study of underground water shows that certain diseases are more rife when waters are high in the ground, and others when the water is low. The conditions that bring about and accompany low water, however, have by far the most potential influence on health, as all low-water years are, without exception, unhealthy. As a rule, the years of high water are usually healthy, except, as often happens, when high water follows immediately upon marked low water, when, on the rise of the water, an unhealthy period invariably follows.

Mr. Latham has found that those districts which draw their water-supplies direct from the ground are usually more subject to epidemics and disease than those districts in which the water-supply is drawn from rivers supplied from more extended areas, or from sources not liable to underground pollution. In the case of Croydon, one portion of the district (under three-fourths) is supplied with water taken direct from the ground, whilst the remaining portion is supplied with water from the river Thames. It is curious to note, that, even so recently as 1885, the zymotic death-rate in the districts supplied with underground water was twice as great as in that part of the district supplied from the Thames; and